Name ____ AP Chemistry

Effusion/Diffusion & Kinetic Molecular Theory

Effusion/Diffusion

Diffusion is the mixing of gases while effusion is the passage of a gas through a small opening into an evacuated chamber. Using a simulation, you are going to look how the rate of diffusion and/or effusion relates to the movement of different gases.

1) Go to http://www.media.pearson.com.au/schools/cw/au_sch_lewis_cw1/int/GasDiffusion/0510.html.
2) Set the height of the opening to 20.0 mm and set gases on both sides to helium. Click "Run" and watch the simulation until there is small change of N_1 and N_2 on each side. Record the time below (note: if the time reaches its limit, record the maximum time).

3) Click "Reset." Now set the height of the opening to 60.0 mm and click "Run." Watch the simulation again until there is little change of N_1 and N_2 on each side. Record the time below.

4) The movement of molecules through the opening is known as effusion. How does the height of the opening affect the rate of effusion?

5) Click "Reset." Repeat steps 2 & 3 with carbon monoxide. Does changing the compound affect the rate of effusion through the opening?

6) Click "Reset." Now look at the mixing of two different gases. Set the gas on the left to helium and the one on the right side as nitrogen. Watch the simulation for 30 seconds and make a note of how fast the molecules of each compound are moving.

7) After 30 seconds, pause the simulation. Record the number of molecules of each compound on each side.

8) Remembering that each side started with 100 molecules of only one compound, which compound (helium or nitrogen) moves to the other side fastest?

9) Click “Reset.” Now choose helium on the left side and carbon monoxide on the right side. Repeat steps 6 & 7. Which compound (helium or carbon monoxide) moves to the other side fastest?

10) Click “Reset.” Now choose helium on the left side and sulfur hexafluoride on the right. Repeat steps 6 & 7. Which compound (helium or carbon monoxide) moves to the other side fastest?

11) Looking at your answer for question 8, 9, and 10, what do observe about the compound and its rate of diffusion (how fast it moves to the other side)? Look at the molar mass of each compound to answer this question.

Thomas Graham found that the rate of diffusion of a gas is inversely proportional to the square root of the molar mass of the compound, as shown through the following equation:

$$\frac{Rate\ of\ effusion\ (gas\ 1)}{Rate\ of\ effusion\ (gas\ 2)} = \frac{\sqrt{Molar\ mass_2}}{\sqrt{Molar\ Mass_1}}$$

Using this equation, calculate the ratio of rate of effusion for helium and nitrogen, helium and carbon monoxide, and helium and sulfur hexafluoride.

How does your answer compare to your answer to step 11?

Kinetic Molecular Theory

Below are the components of the Kinetic Molecular Theory:

- Gases consist of tiny particles (atoms or molecules).
- These particles are so small, compared with the distances between them that the volume (size) of the individual particles can be assumed to be negligible (zero).
- The particles are in constant random motion, colliding with the walls of the container. These collisions with the walls cause the pressure exerted by the gas.
- The particles are assumed to not attract nor repel each other.
- The average kinetic energy of the gas particles is directly proportional to the Kelvin temperature of the gas.

Use this information to answer the following questions.

1) What causes a gas to exert pressure when confined in a container?

2) How does the total volume of gas particles compare to the volume of the space between the gas particles?

3) As the temperature of a gas decreases, what change occurs in the amount of kinetic energy?

4) What property of gas particles is measured by temperature?

5) What is the relationship between temperature and molecular motion?

6) In terms of the kinetic-molecular theory of gases, how can increase in the temperature of a gas confined in a rigid container cause an increase in the pressure of the gas?

7) There is a government warning on all aerosol cans that states: Do not store at a temperature above 120°F (50°C).
   (a) Explain why this warning is required in terms of the relationship between temperature and pressure and kinetic molecular theory.

   (b) What would happen if the can were to be heated above 120°F (50°C)?

8) Why do the manufacturers of tires suggest that tire pressure be checked before a car has been driven any distance?